METHOD, COMPUTER READABLE MEDIUM AND APPARATUS FOR ACCESSING A DEFECT KNOWLEDGE LIBRARY OF A DEFECT SOURCE IDENTIFICATION SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims benefit of United States provisional patent application serial number 60/240,631, filed October 16, 2000, which is herein incorporated by reference. This application contains subject matter that is related to the subject matter described in US patent application serial numbers ________________, ________________, and ________________, (Attorney dockets 4744 FET/MDR, 4747 FET/MDR, and 4748 FET/MDR), filed simultaneously herewith, which are each incorporated herein by reference in their entireties.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] This application claims the benefit of U.S. Provisional Application No. 60/240,631 filed on October 17, 2000, which is herein incorporated by reference.

[0003] The present invention relates to semiconductor wafer processing systems and, more particularly, the invention relates to systems that identify the source of defects for semiconductor wafers as the wafers are processed in a semiconductor wafer processing system.

Background of the Related Art

[0004] Semiconductor wafers are prone to defects that occur during processing. Defects may occur at any stage of the processing of the wafers as integrated circuits are formed thereupon. Generally each fabricator of integrated circuits maintains a database of the causes of defects that occur on a regular basis. If the defect occurs often and a solution is apparent, the database may contain a correlation between the defect, the defect's cause and the solution to the defect. For example, certain defects may occur when a particular chamber becomes dirty. When these defects occur, the database would indicate the solution to be to execute a cleaning cycle for the particular chamber.

[0005] The various integrated circuit fabricators develop their own, proprietary databases of defect information. As such, substantial funds are expended to produce the databases over time.

[0006] Therefore, there is a need in the art for a method for pooling the confidential defect information of multiple integrated circuit fabricators and anonymously sharing the defect information amongst the integrated circuit fabricators. Such sharing of information would substantially reduce the amount of resources consumed in preparing the defect source identification database.

SUMMARY OF THE INVENTION

[0007] The present invention is a method of accessing defect source identification data from multiple integrated circuit manufacturers (database subscribers), fairly compensating the participants for their efforts, and anonymously sharing the data amongst the participants in a manner that protects confidential information. Subscribers that do not share information (non-participants) may also access the defect data for a fee.

[0008] More specifically, the defect source identification (DSI) system comprises a defect knowledge library (DKL), subscriber equipment and a communications network that connects the subscriber equipment to the DKL. The DKL contains a partitioned database of defect, defect source and defect mitigation information that is arranged by participating integrated circuit fabricator (referred to herein as a subscriber). The subscribers can identify the amount and type of information that they wish to share with other subscribers and whether their identity will be disclosed. The subscribers may share the data with specific "partners" or with other departments within their company, without sharing with other subscribers. The DKL system administrator charges a fee for the access rights. The more information that a subscriber shares with other subscribers, the lower the access fee. As such, subscribers are given financial incentive to share their information with other subscribers. Additionally, if a subscriber shares with others, then the other subscriber's data is made available to the sharing subscriber. As such, by sharing data, a particular subscriber has access to an expended library of DSI data without the need to accumulate the data themselves.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] So that the manner in which the above recited features, advantages and objects of the present invention are attained and can be understood in detail, a more particular description of the invention, briefly summarized above, may be had by reference to the embodiments thereof which are illustrated in the appended drawings.

[0010] It is to be noted, however, that the appended drawings illustrate only typical embodiments of this invention and are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

[0011] Figure 1 depicts an illustrative defect source identification (DSI) system that uses the method of the present invention;

[0012] Figure 2 depicts a flow diagram of a setup method for the system of Figure 1; and

[0013] Figure 3 depicts a flow diagram of a method of accessing information in the system of Figure 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0014] The present invention is a method for accessing a defect knowledge library (DKL) of a defect source identification (DSI) system. The DKL stores defect related information from a plurality of DKL subscribers. The access control for each subscriber is facilitated by setting access pricing and access levels, where the access pricing is the price paid by a subscriber to access the information in the DKL and the access level is the amount of information that the subscriber is allowed to access within the DKL. The access pricing and level depends upon the amount of information that the subscriber shares with other subscribers.

[0015] Figure 1 is a block diagram of a DSI system 100 that utilizes the method of the present invention. The DSI system 100 comprises DKL 102, a communications network 104 and a plurality of subscriber equipment 106_1, 106_2 through 106_n (together referred to as subscriber equipment 106, where n is an integer greater than zero).

The DKL 102 comprises a database 108 (physically stored in a computer memory) and a server computer 110. The server computer 110 comprises a central processing unit (CPU) 118, memory 120 and well-known support circuits 122. The CPU 118 may be any one of the available computer processors that are available. The memory 120 may be random access memory, read only memory, disk drive storage, removable storage, or any combination of these memory devices. As described with respect to Figures 2 and 3, the memory 120 stores the software 124 that, when executed by the CPU 118, embodies the methods of the present invention. The support circuits 122 comprise well-known circuits and devices including, but not limited to, cache, power supplies, clocks, network interface cards, input-output circuits, and the like.

[0016] The subscriber equipment 106 comprises a client computer 112_n and a local database 114_n. The client computer 112_n has a similar physical structure as that of the server computer, i.e., a CPU, memory and support circuits. For clarity, these well known elements are not specifically depicted.

[0017] The server computer 110 operates as a conventional "server" computer and the client computer operates as a conventional "client" computer such that a server-client relationship is formed between the DKL 102 and the subscriber equipment 106. In this manner, the database 108 of defect data forms a relational database that receives information from the client computer 112. The communications network 104 couples the DKL 102 to the subscriber equipment 106. The communications network may be an ETHERNET local area network, (LAN), a token ring LAN, an INTERNET based wide area network (WAN), a virtual private network, or a combination of these commonly used network topologies. Generally, any form of communications network that enables the client and server computers to communicate with one another is sufficient for practicing the present invention.

[0018] The client computer 110 operates to collect defect, defect source, and defect mitigation data from a semiconductor wafer processing system 116_n. The system 116_n is coupled to the subscriber equipment 106. The semiconductor wafer processing system 100 contains one or more metrology chambers or stations within which defect and defect source information is generated. The local database 114_n

stores this defect and defect source data. The information from the client database 114, either all or a subset thereof, is communicated to the DKL 102 via the network 104. The subscriber controls the specific amount of data that is communicated to the DKL 102. A distributed defect source analysis system such as the one depicted in Figure 1 is disclosed in US patent application serial number _____, filed simultaneously herewith, (Attorney Docket 4748) and incorporated herein by reference in its entirety.

[0019] Some or all of the local database information is communicated to the DKL database 108 where the DKL database is updated with all of the subscriber's information. Each subscriber has access to a specific partition of the database 110, e.g., partitions P_1, P_2 through P_n. The database 110 stores defect data, defect source identification data, and defect mitigation information in each partition. As such, a common database can be accessed by the subscribers to find solutions for their defects. For example, the subscriber may be having the same defect occur within their semiconductor wafer processing system. The system administrator may have a solution to the defect and make that solution available. The subscriber can be given access to a common partition, e.g., partition C, where all subscribers can access various defect analysis tools and information that are supplied by the system administrator.

[0020] The present invention concerns a method of charging for access to the database 110 in a tiered manner depending upon a subscriber's willingness to share defect information with other subscribers. Specifically, subscribers are provided different pricing levels and access levels depending on the level of sharing that the subscriber authorizes.

[0021] Figure 2 is a flow diagram of an account setup method 200 for the system 100 of FIG. 1. The method 200 is embodied in a software routine that is stored in the server computer memory and, when the CPU executes the software, causes the system to operate in a manner that is outlined by the method 200.

[0022] The method begins at step 202 and proceeds to step 204 wherein the subscriber sets up an account on the server computer. Within the setup process, the subscriber is supplied with passwords and user identification codes that correspond

to their level of access. In step 206, the subscriber identifies the level of sharing that they will allow for their defect information. This sharing level varies from none to all. For example, some subscribers may not share any of their data with other subscribers. Other subscribers may share all of their defect data, but none of their defect mitigation information or defect source identification data. Others may enable other subscribers to access all the data that the subscriber supplies to the database without restriction. Subscribers may also request certain data only be made available to "partners" or affiliated companies that are also subscribers.

[0023] At step 208, the method 200 establishes an access level that is commensurate with the sharing level, i.e., the subscriber is permitted access to other subscriber's defect data in the same degree that they permit access to their data. The system may enable a subscriber to "buy up" such that they can share at one level and access at a higher level by paying a higher price for the enhanced access.

[0024] At step 210, the method 200 sets the access price based upon the access level and sharing level. Generally, the more a subscriber shares, the less expensive the access price. The intent is to provide an incentive to subscribers to share defect information with other subscribers. The pricing can be an access fee, where the subscriber is charged for each use of the server, or as a monthly fee, where the subscriber may access the server as much as desired for a flat monthly rate.

[0025] The system administrator ensures that specific products and subscriber names are not made available to the other subscribers. As such, the defect information that is shared is available on an anonymous basis and does not contain confidential information. The point is to share defect data, defect source identification and defect mitigation information amongst subscribers without compromising the trade secrets of any of the subscribers. Additionally, the subscriber posts much of the information such that the subscriber directly controls what information will be shared. As such, the confidential information can be extracted from the posted information. Such sharing of information enables all subscribers to benefit from the defect research performed by the subscriber base as well as the system administrator. The method 200 steps at step 212.

[0026] Figure 3 is a flow diagram of a method 300 of fulfilling a transaction using the

system of Figure 1. The method 300 is embodied in a software routine that is stored in the server computer memory and, when the CPU executes the software, causes the system to operate in a manner that is outlined by the method 300.

[0027] The method 300 begins at step 302 and proceeds to step 304 wherein the subscriber logs into the server computer through an interface on the client computer. The interface is generally a graphical user interface (GUI) that enables the subscriber to enter the userid and password. Assuming the correct userid and passwords are provided, the method proceeds to step 306 where access to the serve is granted. If incorrect userid or passwords are provided, the step 304 will invoke conventional error handling routines to request re-entry of the login information or block access to the system at step 308.

[0028] Once access is provided, at step 308, the subscriber may access the defect analysis tools of the DKL. These tools enable the subscriber to use an image based analysis suite that performs comparisons of the defects experienced by the subscriber to a defect database. Once the defects have been categorized, they are analyzed to identify the source of the defects. The source can then be used to determine certain defect mitigation techniques to be used to eliminate the defect. Such mitigation techniques may pinpoint certain chambers in the wafer processing system that may need cleaning, certain gases that are contaminated, certain operating parameters of the processing system that need adjustment, and so on. If the subscriber has a high access level, then the analysis tools will use the subscriber's own data plus the data of other subscribers and the system administrator to analyze the defect data. As such, the subscriber has access to a substantial amount of defect information to draw from to determine the source and mitigation techniques for specific defects. If new techniques are developed during the analysis session, they are stored in the database.

[0029] At step 310, a billing database is updated with information that the subscriber has accessed the database. The information that is updated depends upon the subscriber's billing arrangement. For example, if the subscriber is on a use based pricing plan, then the update must contain the duration of the connection and the type of information and tools that were accessed. For monthly subscription type pricing,

the update would only require basic subscriber data to identify which subscriber had accessed the DKL. The system administrator may wish the billing database to contain other statistical information so the system utilization statistics can be accumulated. At the end of the session, the method 300 logs out the subscriber and stops at step 312

[0030] Access to the DKL may be automated such that the subscriber equipment automatically connects to the DKL, supplies defect data, performs an analysis, retrieves the defect mitigation solution, and applies the solution to the semiconductor wafer processing system that is coupled to the subscriber equipment. The only time a person would be notified is if a solution to correct the defect is not readily available from the database.

[0031] While foregoing is directed to the preferred embodiment of the present invention, other and further embodiments of the invention may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.